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Specification and Drawings, as originally filed, with Application for Patent Serial No: **2,300,569**, on March 14, 2000, by **THE LITEBOOK CO. LTD.**, assignee of Larry Verne Pederson, Clayton G. Coffey and Henry Hudema, for "Light Therapy Device".

Agent certificateur/Certifying Officer

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ABSTRACT OF THE INVENTION

A light treatment device is taught including an outer housing having a first member and a second member. The first member and the second member are releasably locked together and are openable to permit access to a compartment. The light treatment device also includes a light emitting assembly having light emitting diodes (LEDs) as a light source. The light emitting assembly is storable in the compartment and is mountable on the housing such that the housing acts as a base to support the light emitting assembly.

LIGHT THERAPY DEVICE

FIELD OF THE INVENTION

The present invention relates to a light therapy device and in particular to a light therapy device for treatment of light deficient disorders and body clock disruptions.

BACKGROUND OF THE INVENTION

There is much support for the use of light therapy to overcome light deficient disorders. It has been proven that treatments involving shining light directly towards a patient's eyes will alleviate or cure disorders including Seasonal Affective Disorder (SAD), circadian sleep disorders and circadian disruptions associated with jet-lag, shift-work, PMS and bulimia.

There are two types of light therapy devices presently available. One type of device is large in size and floor or desk mountable. These devices include light sources of fluorescent bulbs. Although they can be moved from one position to another, they are not generally portable. In addition, the light source is quite fragile. The second kind of light treatment devices are head mountable. These devices are formed as eye glasses or visors. While they are portable, they are not generally accepted by patients for use in public because of their odd appearance when worn on the head. This combined with safety concerns about eye damage given the proximity of the light source to the eye, has resulted in head mountable treatment devices failing to be generally accepted as a light therapy device.

These devices therefore are of limited use for persons requiring a portable and discreet treatment device. A light treatment device is needed for use by, for example, the business traveler that is portable and aesthetically appealing.

SUMMARY OF THE INVENTION

The present invention provides a portable, light weight and attractive light treatment device. The device is durable, being resistant to damage by normal transport. The device uses light emitting diodes (LEDs) as a source of light. LEDs offer a light source that is light weight, small in size, simple, durable as well as energy efficient. The device is useful for travel and for in flight use while being aesthetically acceptable.

In accordance with one aspect of the present invention, there is provided a light treatment device comprising an outer housing including a first member and a second member, the first member and the second member being releasably locked together and a light emitting assembly including a plurality of LEDs, the light emitting assembly being storable in the first member and being mountable on the housing such that the housing acts as a base to support the light emitting assembly.

In one embodiment, the first and second members are pivotally connected and openable in a manner similar to a book. The first and second members, when closed enclose an inner compartment accessible by opening the first and second members about their pivotal connection. The light emitting assembly is storable in the inner compartment. In this embodiment, the light emitting assembly can be mountable on the first member and the second member can act as a base. In one embodiment, an extension arm is mounted between the first member and the second member. The extension arm can be extended to increase the space between the second member and the first member and, where the light emitting assembly is mounted on the first member, to increase the height of the light emitting assembly above the surface on which the device is resting.

In another embodiment, the first member and the second member are pivotally connected. The light emitting assembly is pivotally connected to at least one of the first or second members. The light emitting assembly is pivotally moveable between

a stored position in which it is surrounded at least in part by the first and second members and an illuminating position in which it is open for use.

The LEDs include at least some capable of emitting white-light. In one embodiment, the LEDs are arranged in a pattern over an area and the light emitting assembly is selected to emit light from the LEDs along a substantially straight line directly toward the user. Preferably, a diffuser screen of light diffusing sheet material is positioned over the LEDs to provide a more uniform emission of light. While LEDs do not emit any significant amount of ultraviolet radiation, the diffuser sheet material can include a UV filter, if desired. In another embodiment, a plurality of LEDs are arranged to emit light into a light conducting plate that bends the light by reflection and/or refraction to direct the light outwardly in a selected direction. The light conducting plate provides that the LEDs can be mounted beside the area through which light is directed rather than behind it. The use of a light conducting panel offers many advantages over a screen of LEDs such as, for example, a reduction in cost, complexity, size and weight.

To facilitate therapy using the device, the housing can also accommodate a therapy calculator for determining a treatment regime based on an input of information.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevation view of a light therapy device according to the present invention with the device closed.

Figure 2 is a front elevation view of the light therapy device of Figure 1.

Figure 3 is a side elevation view of the light therapy device of Figure 1 with the device in the open position ready for use.

Figure 4 is a front elevation view of the light therapy device shown in the configuration of Figure 3 with its diffuser screen cut away to facilitate illustration of the LEDs.

Figure 5 is a sectional view along line 5-5 of Figure 4.

Figure 6 is a top plan view of a light emitting assembly useful in the present invention.

Figure 7 is a sectional view along line 9-9 of Figure 6.

Figure 8 is a sectional view through another light therapy device according to the present invention.

Figure 9 is front elevation of another light therapy device according to the present invention.

Figure 10 is a side elevation of the light therapy device of Figure 9.

Figure 11 is a top plan view of the light therapy device of Figure 9 in the closed position.

Figure 12 is a side elevation of the light therapy device of Figure 9 in the closed position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figures 1 to 5, a light therapy device according to one embodiment of the present invention is shown. The device has an outer housing including an upper housing member 10 and a lower housing member 12. The housing members are connected by a hinge 14 that permits them to pivot relative to each other between a closed position shown in Figures 1 and 2 and an open position shown in Figures 3 and 4. When in the closed position, the housing members can be releasably locked together by a catch 16. The device is small in size and, when closed, resembles a small case or lap-top computer. Preferably, the outside dimensions of the device are about 13 inches wide, 4 inches high and 12 inches deep. The size can be varied as desired and with consideration as to portability, convenience and the components that must be contained therein. A handle 18 is preferably secured to the outer surface of the housing to facilitate transport.

Upper and lower housing members are preferably formed of a durable, impact resistant material such as, for example, a polymer (i.e. nylon, thermoplastic or blends thereof). Preferably all housing parts are of minimal thickness to provide selected

degrees of impact resistance and support for internal components so that the weight of the device is minimized.

The housing encloses a light emitting assembly 20. In the illustrated embodiment, light emitting assembly 20 is mounted in the upper housing member. The light emitting assembly is mounted in an indent 22 on the inwardly facing portion of the upper housing member so that, when the device is in the closed position, assembly 20 is protected within the housing members. In this way, the light emitting assembly, which is more fragile than the housing, is protected against damage during transport.

The device is opened for use to administer a light treatment. In a preferred embodiment, upper housing member unfolds from the closed position by rotating about hinge 14. Lower housing member 12 includes a base12a and an extension arm 12b connected by a second hinge 24. The extension arm can be rotated about hinge 24 to elevate the upper housing member relative to base 12a. Thus, the height of the light can be selected. Preferably the extension arm is formed, as shown, to fit within the base when the device is in the closed position. Preferably, each of hinges 14 and 24 are of the kind that permit self locking in at least a few rotational orientations. The use of such hinges permits that, for example, upper housing member can be oriented to direct the light downwardly (as shown in phantom), horizontally or, if preferred, in other directions. This is useful as it may be necessary, depending on the treatment, to have the light directed into the patient's eyes or alternately downwardly toward a work space.

Base 12a is selected to support extension arm 12b and upper housing member 10 when in the elevated position. Counterweights (not shown) can be mounted in the base to prevent the device from tipping. Base 12a can also be formed to accommodate electronics, batteries etc. or to define storage space such as for cords, adapters, glasses or other items.

Light emitting assembly 20 includes a printed circuit (PC) board 26 providing electrical connection for white light emitting diodes 28. The LEDs are spaced apart

on the board, with consideration as to their light output and wavelength, such that the assembly emits a light of selected illumination. In one embodiment, as many as 600 white light LEDs are mounted on a board of 6 inches by 8 inches to provide a light which is the equivalent of 10,000 lux at about 20 inches. This provides a level of illumination that has been recognized as being useful for bright-light therapy. The size of the board and the number of LEDs thereon may be considerably reduced as the efficiency of LEDs increases. The board can also be made smaller as we better understand the required area of illumination.

In one embodiment, a diffuser screen 32 is mounted over the diodes to create more uniform light emission. Preferably, LEDs 28 are mounted a suitable distance from diffuser screen 32 such that the light emitted by each LED overlaps on the screen and avoids the appearance of individual points of light behind the screen.

Power is supplied to the LEDs through electrical lines 34 passing through channels in the housing and through hinges. Power can be provided through batteries or preferably to reduce weight through a jack 36 for connection to a 120v electrical supply (for use in North America). Since the device is particularly useful for treatment of jet-lag, an adapter can be provided within the device or separately for conversion to other voltages of AC power or to DC power as is provided through power ports mounted in aircraft armrests.

Referring to Figures 6 and 7 another light emitting assembly 20a is shown. Light emitting assembly 20a is useful in the present invention and can reduce the size of a light therapy device over the device shown in Figures 1 to 5. In particular, light emitting assembly 20a can be used to replace the assembly of the PC board, the LEDs and the diffuser screen in Figures 1 to 5.

Light emitting device 20a includes a light conductive plate 50 having conductive edges 52 and a conductive surface 54. LEDs 56 are positioned along at least one of the conductive edges 52 of the plate. In the illustrated embodiment, LEDs 56 are mounted on two PC boards 58 to direct light at the conductive edges. Preferably, the

LEDs are positioned in a row the same length as the conductive edge such that light is directed into conductive plate 50 along substantially the entire length of its conductive edges. Edges 60 and surface 62, opposite conductive edges 52 and conductive surface 54, respectively, are coated with a reflective film to prevent light from being conducted therethrough and to enhance reflection of light into the plate and out through conductive surface 54. Conductive edges 52 are angled, indicated at *a*, relative to the plane, indicated at 61, of the plate and LEDs are correspondingly angled with respect to edges 52 to direct the light into edge without reflection off the edge surface. Thus, light emitted by LEDs 56 passes into conductive plate 50 and is reflected by surface 62 and edges 60 to be conducted through surface 54.

In bright-light therapy, it is sometimes useful to combine light of different wavelengths. Therefore, LEDs 56 can be entirely of the type emitting white light or, alternatively, LEDs emitting light of various wavelengths (i.e. red or amber) can be used with white light emitting diodes.

Plate 50 is preferably between about .25 and .5 inches thick and is formed of clear material, for example, acrylic or polycarbonate such as Lexan™. Accordingly the light emitting assembly is light weight and durable. As an example, the upper member of Figure 5 is about 1.5 inches thick while an upper member including the light emitting assembly of Figure 6 can be about 1 inch thick.

Figure 8 shows a light therapy device including another light emitting assembly useful in the present invention. One housing member 10a of the therapy device houses the light emitting assembly. Two PC boards 58 carrying a plurality of LEDs 56 are positioned to emit light from the LEDs into a chamber 64. Chamber 64 is an air-filled space. In one embodiment, chamber 64 is defined by a reflective surface 65 that reflects light outwardly toward the rear side of a light conductive plate 50a. Light conductive plate 50a includes a film 66 selected to reflect or refract the light and direct it towards a light conductive surface 67. The preferred film is that known as 3M Optical Light Film™ available from 3M Company. The film is relatively flexible and preferably is supported by a clear material support 68 such as a polycarbonate

panel. The light emitting assembly of Figure 8, can be about the same thickness as, but is less heavy than, that shown in Figure 6.

Referring to Figures 9 to 12, another light therapy device according to the present invention is shown. The device includes a first housing member 70, a second housing member 72 and a housing 73 including a light emitting assembly 74. The housing members 70, 72 are formed as U-shaped members having bases 70a, 72a, respectively, and arms extending therefrom. The arms of the first and second members are connected together by hinge pins 76. The hinge pins permit pivotal movement of the first and second members between a closed position (Figures 11 and 12) wherein first assembly nests within an opening 75 in second member 72 and an open position (Figures 9 and 10). In the open position, the first and second members are positioned to support the housing of light emitting assembly 74 in an elevated position. In the closed position, the first and second members together form a flat unit suitable for storage or to support light emitting assembly 74 in a low position. To facilitate use of the device, preferably hinge pins 76 are adapted such that the first and second members can only be oriented in the fully open position and the fully closed position.

Housing 73 is formed of a durable material such as, for example, impact resistant polymeric material. Housing 73 is pivotally connected to first housing member 70 through hinges which can be extension of hinge pins 76. The hinges permit rotation of housing 73 of the light emitting assembly through a plurality of locations some of which are shown in phantom in Figure 10.

For storage of the light therapy device, housing 73 rotates into an opening 78 formed between the arms of first member 70 and first member is nested in the opening of second member, as best shown in Figure 11.

Preferably the hinges between housing 73 and first member 70 are adapted such as by a cooperating assembly of a detent pin and dimples to permit the light emitting assembly to be releasably locked in only selected locations.

Second member 72 includes a side panel 79. When the housing of light emitting assembly 74 is stored, light emitting assembly 74 is positioned behind side panel 79 and is protected by it. In the illustrated embodiment, side panel 79 is slidably mounted on second member 72. In particular, return flanges (cannot be seen in the Figures) are formed on the side edges of the panel. The return flanges engage into and are moveable along channels 80 formed on the second member. With this mounting arrangement, side panel 79 can be slid up towards hinge end 72b of the second member to act as a lock against inadvertent rotation of housing 73 out of the stored position. This panel position is shown in Figure 11.

The housing around light emitting assembly also accommodates a calculator 81 including a display 82, a key pad 84 and a processor mounted within housing 73. Calculator 81 is programmed to calculate a light treatment regime based on input of information. The calculator processor uses calculation references such as that known as the Jet Lag Calculator™ available from Bio-Brite, Inc., Maryland. In one embodiment, the calculator calculates light treatment regimes for jet lag based on inputs of information, as follows:

Option 1

i. Number of time zones crossed during trip

ii. Direction of time zones crossed (East or West)

iii. Normal wake-up time of patient (for establishing the patient's "body clock")

Option 2

i. Departure city

ii. Arrival city

iii. Normal wake-up time of patient

Based on the input of the above-noted information, the calculator will then calculate and display a treatment regime including, for example, a period of light exposure and

a period of light avoidance. In option 2, the calculator determines the number of time zones through which travel will occur and uses this to calculate treatment regime. The calculator in one embodiment calculates a two-day treatment regime.

In one embodiment, the calculator keypad includes keys to be depressed when inputting particular information. As an example, the keypad can include keys such as: "Departure City", "Destination City" and "Wake up time". The calculator can be adapted to prompt the patient such as by displaying questions requesting the appropriate information. Preferably, the calculator includes a pause function capable of recording a time of treatment interruption and capable of outputting from memory the portion of the treatment remaining when treatment is resumed.

In addition or alternately, calculator can be programmed for calculation of other treatment regimes such as, for example, for treatments to alleviate tiredness in shift workers. Treatments for shift workers may include inputs such as work shift start time, previous shift time and normal waking time.

A speaker 88 is preferably provided for communication to the user. As an example, the speaker can communicate with the calculator processor to audibly prompt a user to input information. In addition, the speaker can function to emit an audible signal, such as an alarm, to alert a user to commence or modify a treatment. In one embodiment, the calculator processor controls a switch for the light emitting assembly such that it is turned on or off in response to a signal from the processor.

In a preferred embodiment, the calculator memory is capable of storing previous treatment regimes. These stored treatment regimes can be recalled from processor memory for repeat trips.

If desired, to enhance the usefulness of the device, the calculator can also be programmed with other information including a clock, a standard mathematical calculator or other information such as an address book, etc.

Numerous modifications, variations and adaptations may be made to the particular embodiments of the invention described above without departing from the scope of the invention as defined in the claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A light treatment device comprising an outer housing including a first member and a second member, the first member and the second member being releasably locked together and a light emitting assembly including a plurality of LEDs, the light emitting assembly being storable in the first member and being mountable on the housing such that the housing acts as a base to support the light emitting assembly.

2. The light therapy device of claim 1 wherein the first and second members are pivotally connected.

3. The light therapy device of claim 1 wherein the light emitting assembly is mounted onto the first member and the second member forms a base for support of the first member.

4. The light therapy device of claim 3 further comprising an extension arm mounted between the first member and the second member.

5. The light therapy device of claim 1 wherein the LEDs include at least some capable of emitting white-light.

6. The light therapy device of claim 1 wherein a diffuser screen of light diffusing sheet material is positioned over the LEDs.

7. The light therapy device of claim 6 wherein the diffuser screen includes a UV filter.

8. The light therapy device of claim 1 wherein the LEDs are arranged to emit light into a light conducting plate, formed to reflect and/or refract the light internally and to direct it toward a light conductive surface for emitting the light.

9. The light therapy device of claim 1 wherein the housing accommodates a therapy calculator for determining a treatment regime based on an input of information.

FIGURE 1

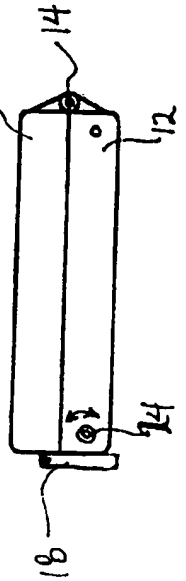


FIGURE 2

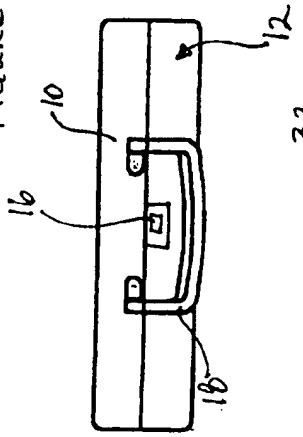


FIGURE 3

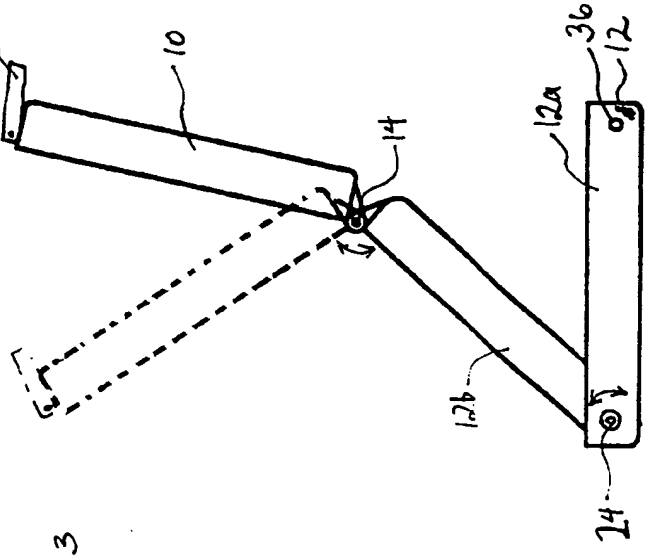


FIGURE 4

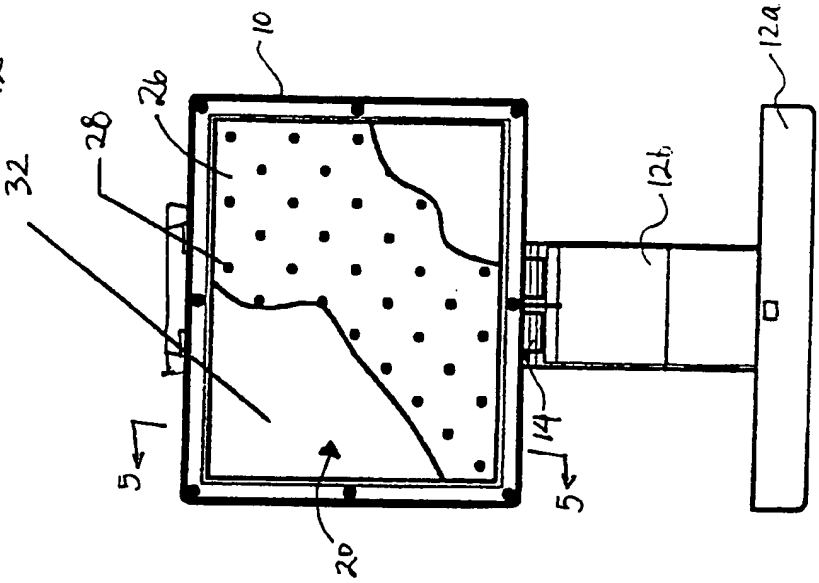


FIGURE 5

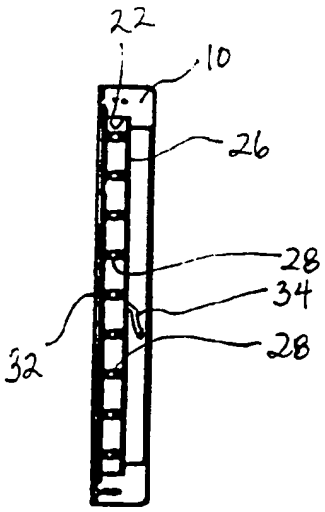


FIGURE 6

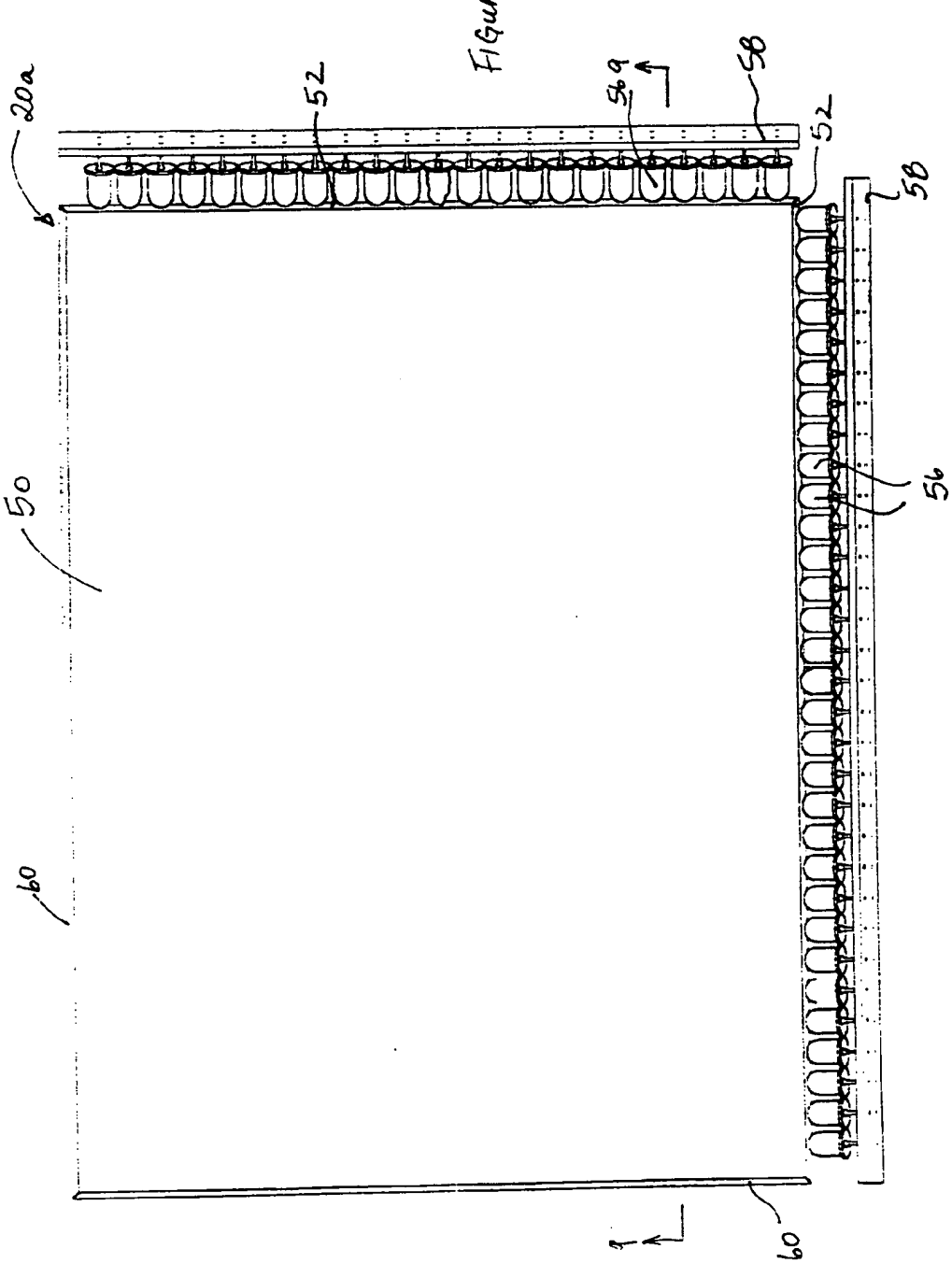
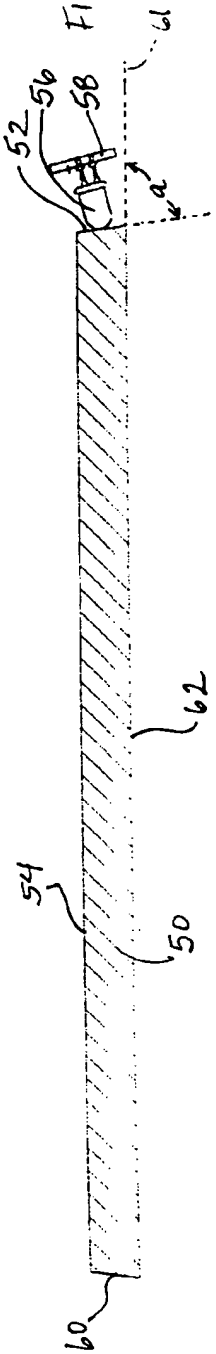


FIGURE 7



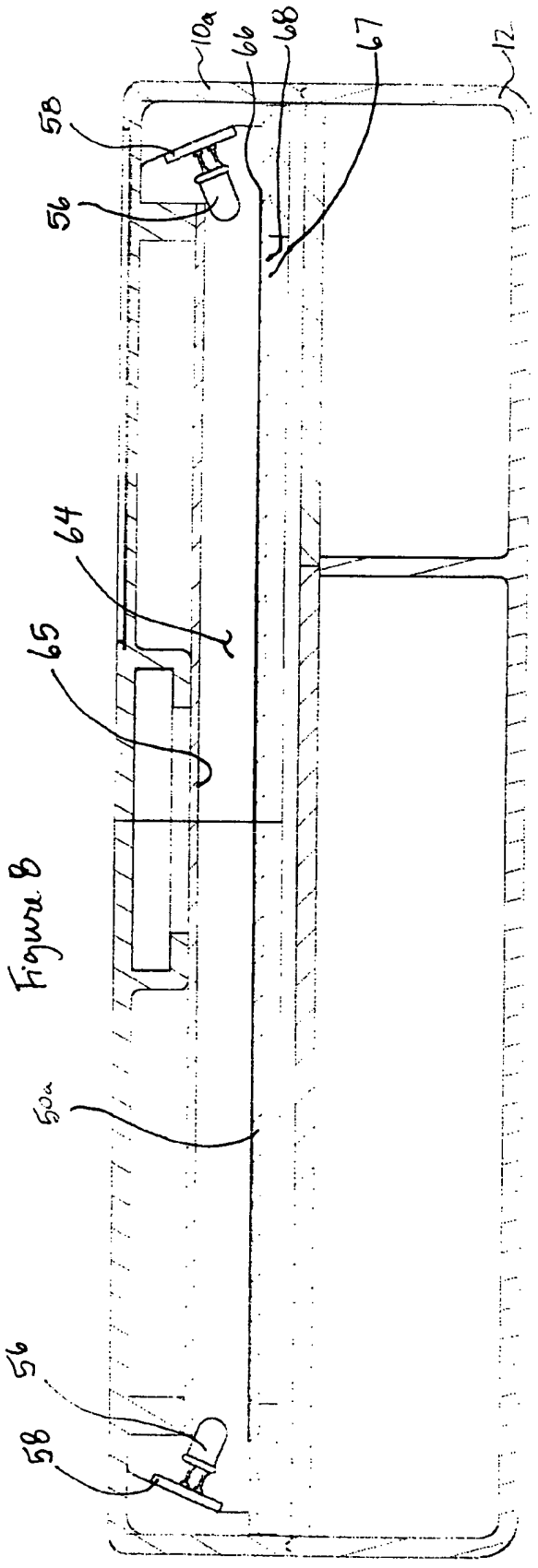


Figura 8

Figure 10

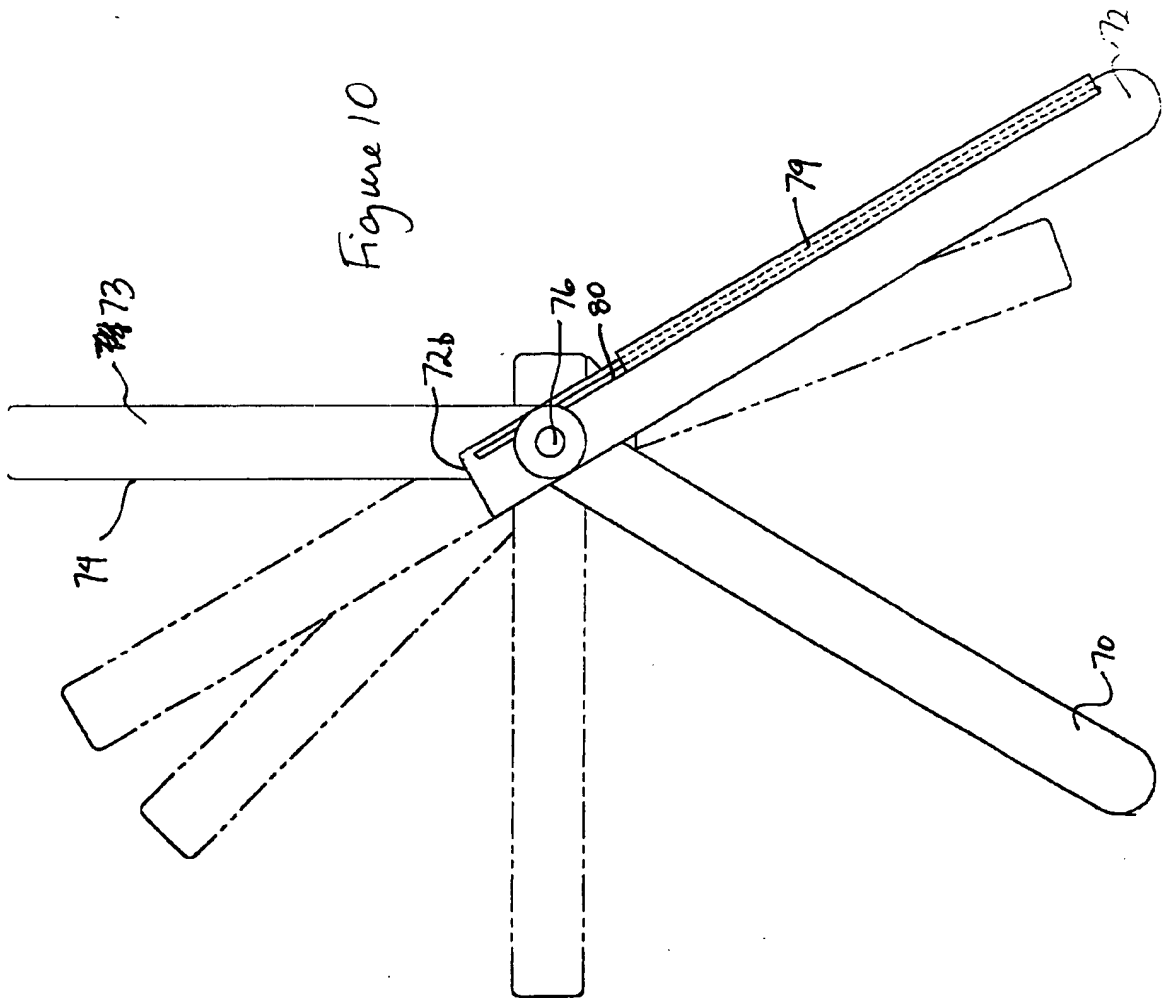
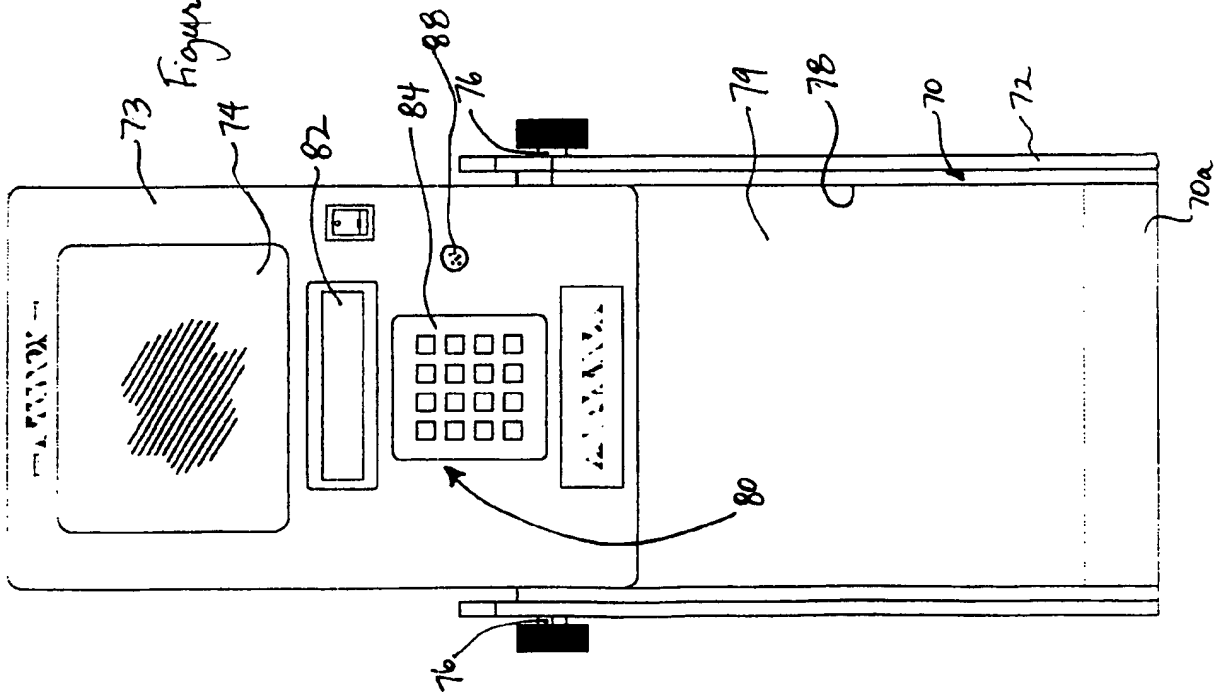


Figure 9



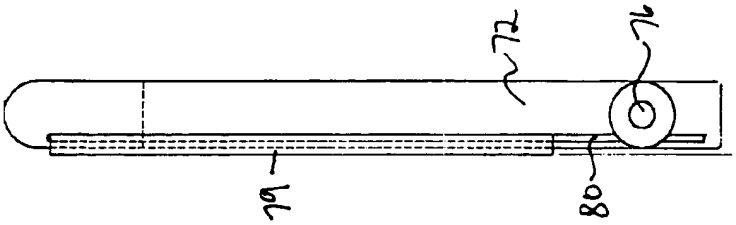


Figure 12

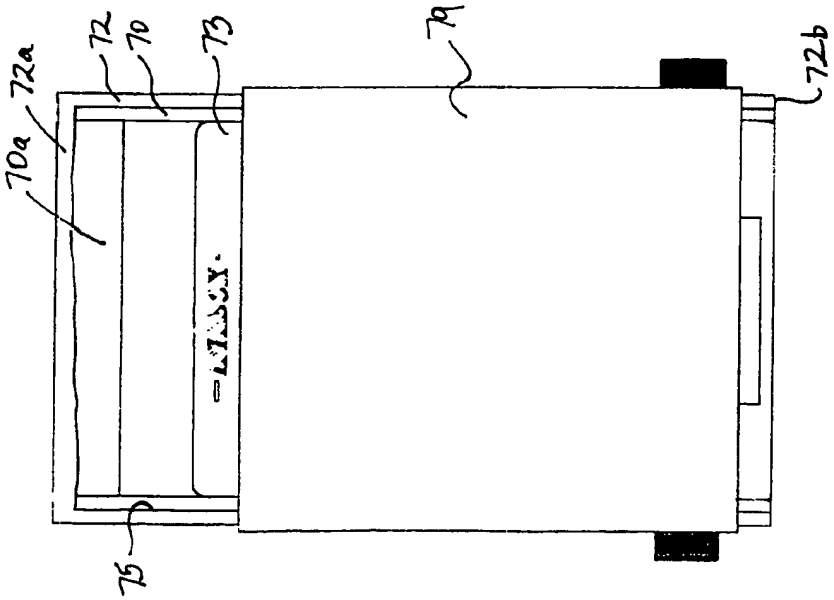


Figure 11